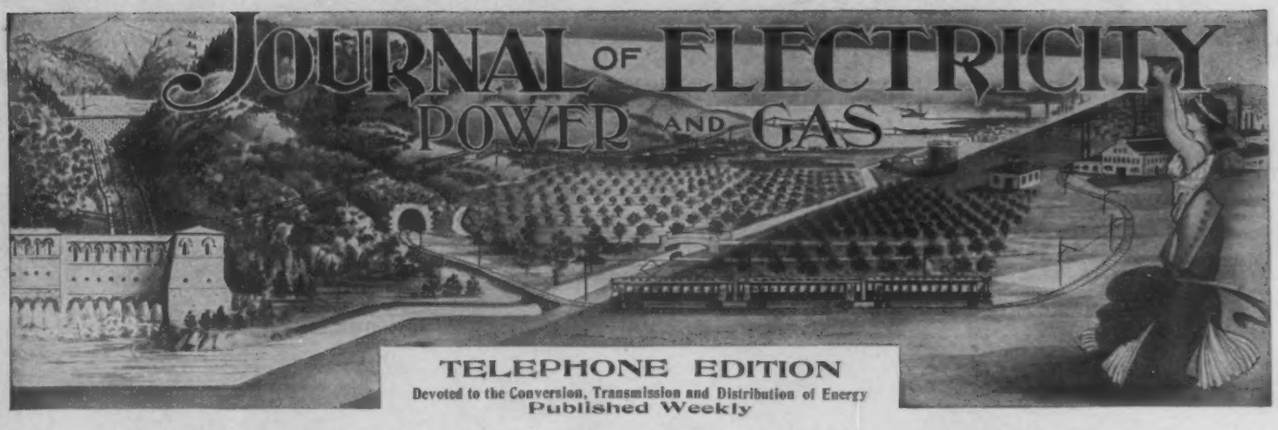


By the Technical Publishing Company, 111 New Montgomery Street, San Francisco Cal.
Entered as second-class matter May 7, 1906, at the Post Office at San Francisco Cal., under the Act of Congress March 3, 1879.

Vol. XX. No. 21 San Francisco, Cal., May 23, 1908. Yearly subscription $2.50. Single copies 10 cents Back numbers prior to current month 25 cents.

INSULATORS

The most perfect glass insulator made is the HEMINGRAY TEAT INSULATOR.

The Teats on the lower rim of the petticoat attract the water on the outer and inner surfaces of the insulator into drops. The water drops from these points on to the cross arm, thereby preventing the moisture from creeping to the pin.

A Complete Stock Carried

Electric Appliance Company
726-728-730 Mission Street
San Francisco

STANDARD UNDERGROUND CABLE CO.
MANUFACTURERS OF
BARE AND INSULATED WIRES AND CABLES
CHICAGO PITTSBURG PHILADELPHIA ATLANTA
NEW YORK BOSTON ST. LOUIS SAN FRANCISCO
Pacific Coast Dept., A. B. Sturman Manager, Shreve Bldg., San Francisco, Cal.
SUB-OFFICE—LOS ANGELES, CAL.

OKONITE WIRE
OKONITE
TRADE MARK.
REG. U. S. PATENT OFFICE
The Standard for Rubber Insulation
OKONITE TAPE, MANSION TAPE,
CANDEE WEATHER-PROOF WIRE,
CANDEE (PATENTED) POTHEADS.
THE OKONITE COMPANY, LTD.,
253 BROADWAY NEW YORK

PARANITE
INDIANA RUBBER AND INSULATED WIRE CO.
MANUFACTURERS OF
PARANITE AND PEERLESS RUBBER COVERED WIRES AND CABLES
Underground, Aerial, Submarine and Inside Use
TELEPHONE, TELEGRAPH, AND FIRE ALARM CABLES
All Wires are Tested at Factory JONESBORO, IND.
Electric Appliance Company
728 Mission St., San Francisco, Pacific Coast Agents

Specify
Brookfield
Glass Insulators
The Standard

VULCAN
Refrigerating and Ice Making Machinery
Manufactured by
VULCAN IRON WORKS
OFFICE: 702 ATLAS BLD'G. 604 MISSION STREET WORKS: FRANCISCO AND KEARNY STS.
San Francisco, California.

The National Conduit & Cable Co.
Manufacturers of
TROLLEY WIRE
BARE COPPER WIRE AND CABLES
WEATHER-PROOF WIRES AND CABLES
PAPER-INSULATED CABLES
FOR TELEPHONE, TELEGRAPH AND POWER
703 MONADNOCK BUILDING, SAN FRANCISCO, CAL.
C. H. PENNOYER, PACIFIC COAST MANAGER

California Casket Co. Bldg.

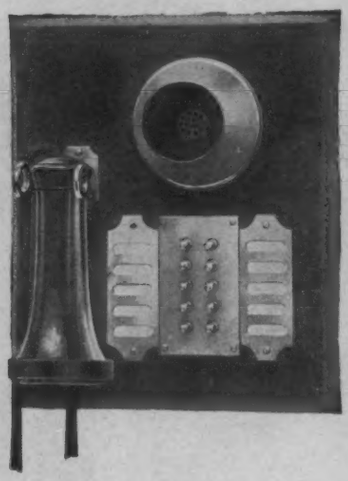
VAN EMON ELEVATOR CO.
Manufacturers Of ... HIGH-GRADE ELEVATORS
R. J. DAVIS, President
B. C. VAN EMON, Vice-President and Manager
N. B. RATHBONE, Secretary and Treasurer
NOT IN THE ELEVATOR TRUST
DIRECTORS
LOUIS F. MONTEAGLE W. P. PLUMMER
GEO. M. PINCKARD R. S. HUNKINS
Office and Construction Department
TECHNICAL BLDG., 111 NEW MONTGOMERY ST.,
SAN FRANCISCO
Factory and Foundry
WEST BERKELEY, CAL.
(32,000 sq. ft.)

Atlas Bldg.

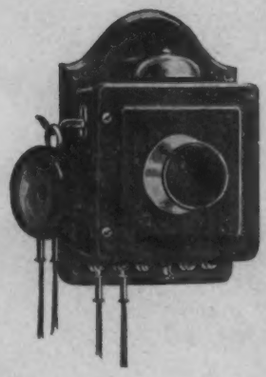
STANDARD—TELEPHONES

Intercommunicating and Interior Telephones—Switch Boards—Accessories
MAGNETO and Common Battery
San Francisco Delivery

Annunciator Catalog 15 Ready for Mailing



Telephone Catalog 8 Ready for Mailing



High Quality
Every Kind of Instrument Made

Right Prices
No Order Too Large
No Order Too Small

Couch & Seeley Co.
Boston, Mass.

We solicit your inquiries

Standard Electrical Works
San Francisco, Cal.

"CENTURY"

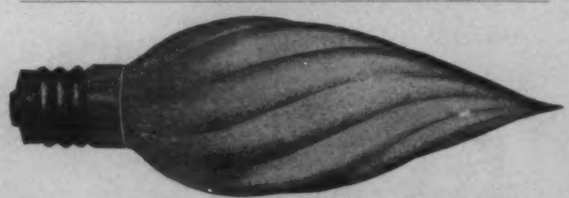
Single Phase MOTORS

are the result of years of experience in the design and construction of this type of motor.

They are self starting under load, efficient, automatic in operation, and constructed for severe service.

Manufactured by
CENTURY ELECTRIC COMPANY
ST. LOUIS, MO.
Standard Electrical Works, Agents, San Francisco

All Kinds of Lamps



California Incandescent Lamp Co.
Kearny 1077 — 117 New Montgomery St., San Francisco

SIMPLEX

Varnished Cambric

LEAD COVERED
FLAME PROOFED

PROMPT SHIPMENTS

INSULATED
WIRES and CABLES
RUBBER — CAMBRIC
THE SIMPLEX ELECTRICAL CO - BOSTON

THE
Journal of Electricity, Power and Gas

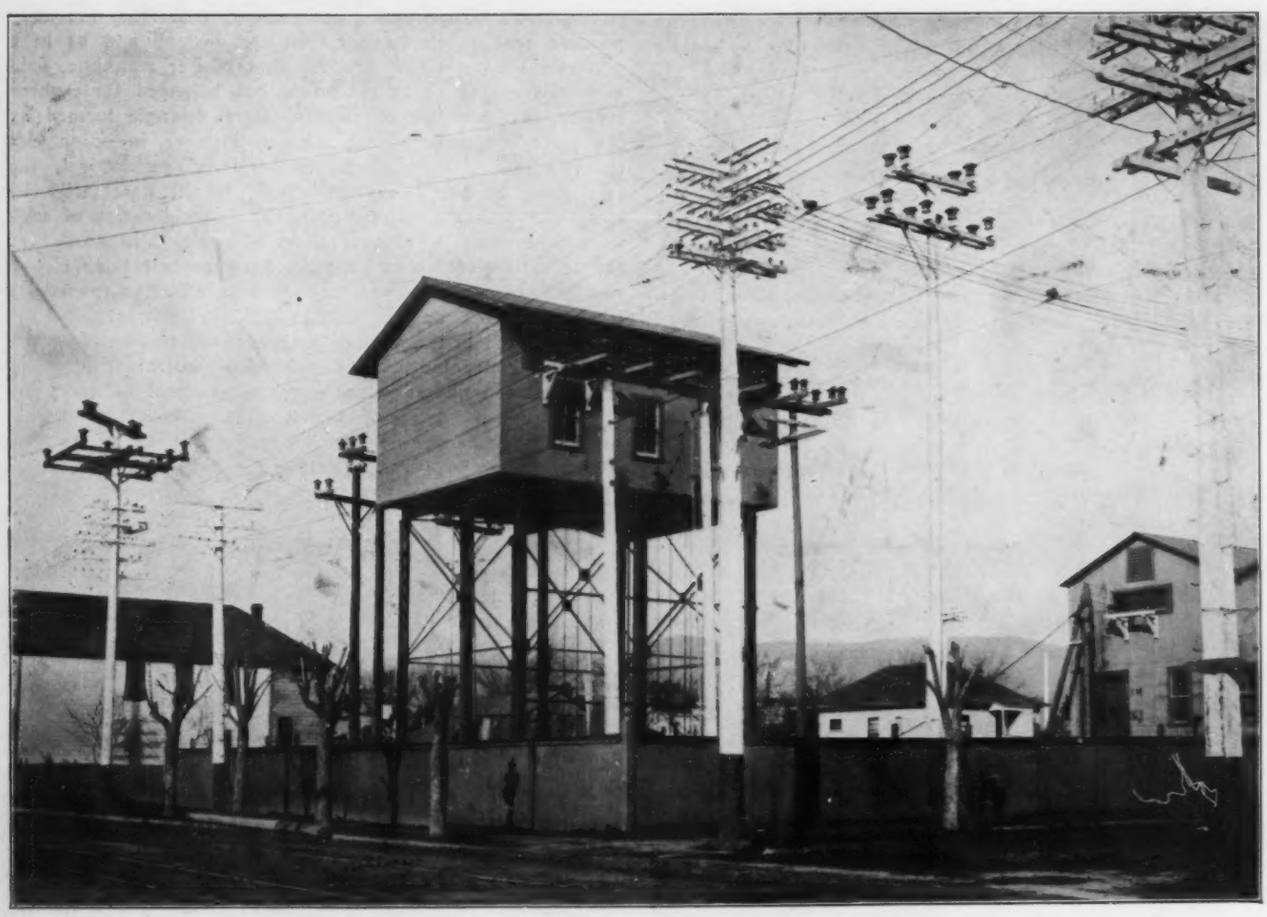
Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., MAY 23, 1908 No. 21

Inductive Interference with Telephone Circuits in Proximity to High Potential Transmission Lines*

By Elam Miller.

The matter of inductive interference to long distance telephone lines in proximity to high tension transmission circuits is a question that is becoming more serious daily. Telephone companies seem to have borne the brunt of many of the changes that have taken place in the development of other electrical industries operating overhead circuits. This effect was felt first in the local plants. Among the more important changes was the radical one originally necessitated by the introduction of the direct current electric railway on the then existing grounded telephone circuits, which required the installation of metallic circuits. A more recent development that has had a decided effect upon the open local wire plants is the introduction of the series alternating current arc circuit, which has forced many of these local telephone circuits into cable before the economical time to resort to such construction. The loss of revenue pending the latter changes and the premature expenditures necessitated thereby amount to many thousand dollars more than is probably generally realized. Though the matter of induction to local telephone circuits is, of course, a serious one, the general introduction of the all-cable plant has, in a measure, rendered this less so. In many of the smaller exchanges, however, this matter of alternating current arc circuits is still a troublesome one.



EXAMPLES OF POWER LINE PARALLELING TELEPHONE CIRCUIT.

The question of induction to local telephone circuits is, however, trivial as compared with the interference with toll service, which occurs to a greater or less degree wherever telephone toll lines parallel high tension transmission circuits for any considerable distance with, say, a separation of 60 feet or less. This considers practically all parallels on county roads, and these remarks are intended to apply particularly to such cases.

It is probable that this paper will prove quite incomplete without a preliminary consideration of the effect of electromagnetic and electro-static induction to telephone lines from

*Paper read before San Francisco Section, American Institute Electrical Engineers, April 18, 1908.

foreign electrical circuits with respect to the two sides of a metallic telephone circuit, or what may be termed "lateral" induction. As a result of the varying magnetic field surrounding conductors carrying alternating current, an electromotive force is induced by transformer action in adjacent conductors. If the adjacent conductors compose the two sides of an untransposed telephone circuit, it is evident that as one wire is nearer the power wire than the other and is consequently in a stronger field, the induced potential in this wire is greater than in the other. There is, therefore, at any instance a difference in potential between the two sides of the telephone circuit with a consequent flow of current through the terminal apparatus in order to equalize it. Under ordinary conditions lateral electro-magnetic induction can be readily overcome by transposition of the telephone circuit. Theoretically, one transposition in the exact center of the exposure, assuming that the separation between telephone circuit and power circuit is equi-distant throughout its length, will overcome this effect, and experiments have shown quite conclusively that one transposition ordinarily does.

As a result of the varying electric field surrounding a conductor having an alternating E. M. F., electro-static charges are induced in adjacent telephone circuits by simple electro-static induction. In this case, however, the explanation for current flowing through the telephone apparatus is somewhat less simple than in the case of electro-magnetic induction, and requires a diagrammatic explanation. It is also a fact that in the case of electro-static lateral induction the single transposition at the center of the exposure does not theoretically neutralize the effect and prevent the flow of current through the terminal apparatus. It can be shown that electro-static lateral induction can never be entirely overcome by transposition of the telephone circuit, but in practice it can be reduced so appreciably by sufficient and properly spaced transpositions as to render its effect unnoticeable. A particularly complete discussion of the effect of electro-static induction between adjacent telephone circuits, or "cross-talk," as it is called, will be found in a paper and subsequent discussion in the Proceedings of this Institute for 1891. The paper was prepared by Mr. J. J. Carty, the present Chief Engineer of the American Telephone and Telegraph Co. The remarks apply equally well to induction from adjacent telephone circuits or foreign electrical circuits. It is, of course, evident that both electro-magnetic and electro-static induction will usually take part in the creating of disturbance simultaneously. The relative importance of each is, in a measure, determined by the character of the disturbing circuit, but with the class of circuits that we are now considering, the effect of electro-magnetic induction is probably very slight. It is, perhaps, fortunate that a transposition scheme applied to telephone circuits calculated to overcome the effects of static induction, is all that need be considered, as these transpositions are usually more than sufficient to care for the electro-magnetic effect. The converse, however, does not by any means hold true.

In so far as lateral induction is concerned, telephone companies are in a fair way to care for themselves, as the disturbance is comparatively easy to reduce, or for practical purposes, eliminate. It is not, therefore, lateral induction that is a particular menace at this time, but an entirely different condition. I refer to the establishment of a difference in potential between both sides of the telephone circuit and ground, as follows:

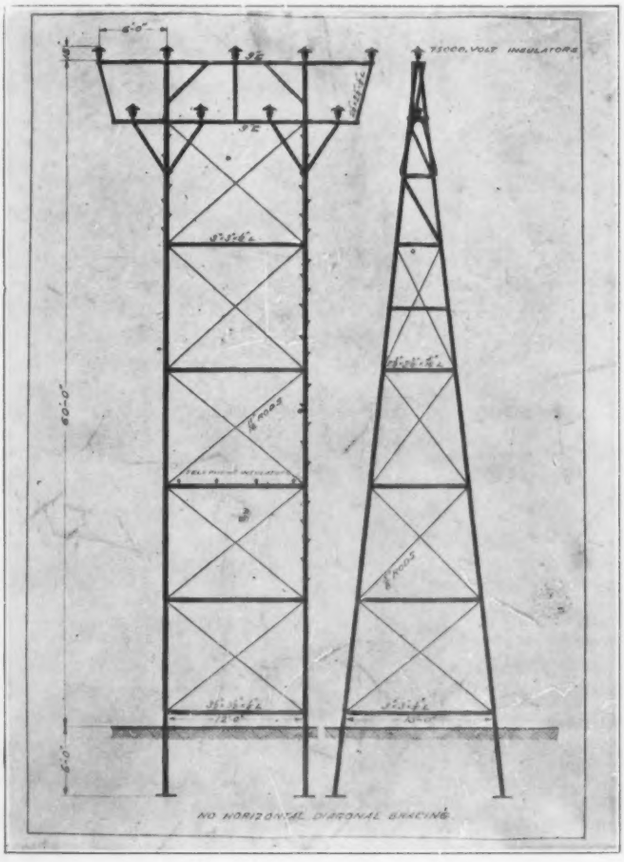
Consider two condensers in series, one having for its plates power and telephone line, both sides of the latter considered as one, and the other, the telephone line and ground. Assume for an instant for the power wire, a single wire having impressed upon it an alternating E. M. F., one side of the alternating current source applied to the wire and the other to earth. As far as the static effect which we are now considering, is concerned, the wire need not be carrying current, so that we may consider it open at the far end. The flow of charging current, and consequent fall of potential from power wire to earth, takes place through these two air condensers, and by considering the capacity reactance of each, the distribution of potential can be shown to be inversely proportionate to the separate capacities. Such a condition would, of course, only obtain on a high tension transmission circuit, where the circuit was operated with a "Y" connection and a grounded neutral, when two of the phases were temporarily out of commission. The condition, however, that does obtain in practice and with the three-phase power circuit in perfect balance, is due to the potential impressed upon the telephone wires as a result of the fact, in that the three phases of the power circuit have an appreciable separation as compared with the separation between any one of the three and the telephone circuit, that the potential that is impressed upon the latter is greatest from the power wire nearest it, the neutralizing effect of the other two not being complete because of this difference in distance. This, of course, applies only when the power circuit is untransposed. Theoretically, therefore, the only position that a telephone circuit can occupy and be in a perfectly neutral static, and for that matter magnetic, field with relation to an untransposed but balanced three-phase system, is the center of an equi-lateral triangle formed by the three-line wires of the circuit. Further, in order that the two sets of circuits may be perfectly symmetrical, the two sides of the telephone circuit would necessarily be spiralled, as with a twisted pair. The consideration of such an arrangement is, of course, an absurdity. In so far as the actual difference in potential between telephone circuit and ground is concerned, due to this effect, it obviously largely depends on the voltage of the power wires to ground. This in the case of a three-phase transmission circuit "Y" connected with a grounded neutral with 60,000 volts between phases, which gives a potential between any one phase and ground of 60,000, or, say, 35,000 volts, has, with varying lengths of exposure at various separations, been noted to have varied between about 80 volts and 750 volts. In order to predetermine by calculation the induced potential between telephone circuit and ground that may be expected it would be necessary to at least have the following data:

Telephone Circuit—Size of wire; length of circuit; distance above ground.

Power Circuit—Size of wire; how connected—delta or star; potential above ground; distance from telephone circuit; distance parallel to telephone circuit; distance between power wires.

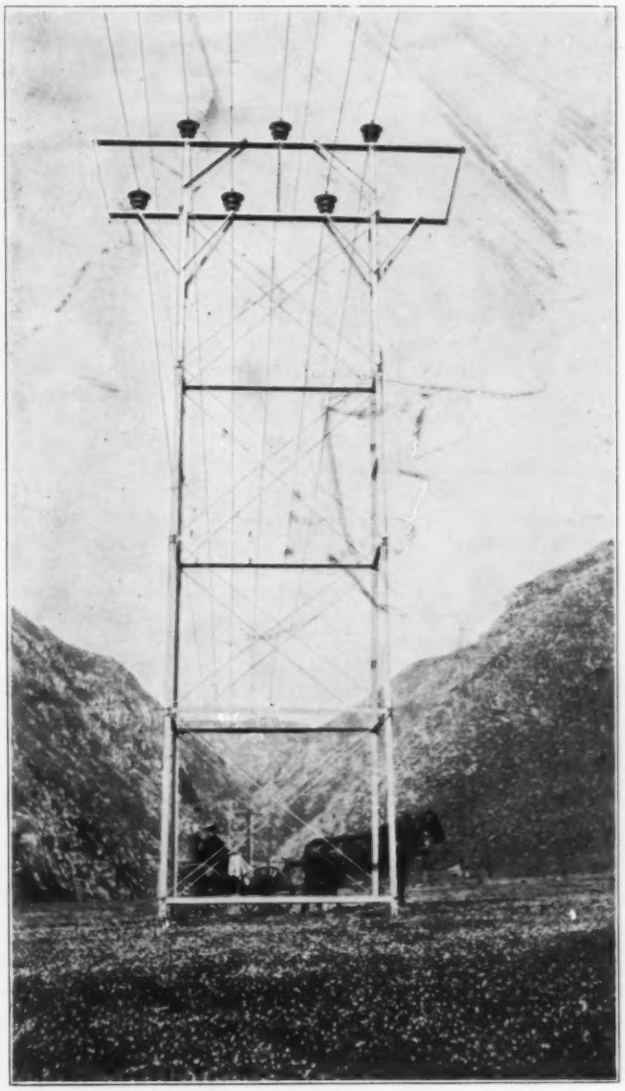
This information will, in a measure, permit of an approximation of the disturbance that may be expected from a given exposure, but the actual effect is so varied by other conditions that it has been our experience that any attempt to predetermine the effect of an exposure is usually unsatisfactory. Before considering further the effect of the establishment of a difference in potential between telephone line and ground, it should be stated that the amount of current flowing through the receivers at either end, which will ordinarily render the average long distance conversation unintelligible, depends largely on the transmission equivalent of the telephone circuit. It is a fact, however, that current in excess of 10 micro-amperes superimposed upon the voice current will ordinarily produce sufficient disturbance to interfere greatly with long distance telephone transmission. By considering the following it will be understood why the establishment of a difference in potential between the telephone loop and ground almost invariably results in interference. Were it possible to maintain the insulation resistance and dielectric strength, together with the capacity

of the two sides to ground, at exactly the same figure, it is, of course, evident, that, irrespective of the potential that existed on the two sides of the loop considered as one, no current would flow through the terminal apparatus. This, however, is a condition that even with the most perfect maintenance is obviously impossible. On all commercial lines it is an invariable fact that there is some difference in the insulation resistance to ground of one wire as compared with the other, and also that the other factors vary. If, therefore, this is the case, it is evident that there is a flow of current to ground from one wire greater than from the other, and a consequent flow of current through the receivers at either end in order to equalize the potential of the two sides. With a comparatively low impressed potential on the telephone circuit this difference in insulation resistance, dielectric strength or electro-static capacity



STEEL TOWERS WITH HIGH VOLTAGE AND TELEPHONE INSULATORS

may be sufficient to result in the flow of enough current through the receivers at either end to produce an appreciable effect. It must also appear evident that transposition of the telephone circuit leaves the case practically unaltered. In order, therefore, as a preliminary to prevent as much as possible the establishment of a difference of potential between the two sides of the telephone loop and ground, it is evident that the power circuit must itself be transposed. This transposition of the power circuit, to be theoretically correct with respect to the paralleling telephone circuit should, of course, make one complete barrel opposite the exposure. If the separation is the same for the entire length of the exposure the transpositions should be made equi-distant so that the power line will be divided into three equal lengths, assuming, of course, that we are considering a three-phase circuit. If, however, the distance varies, it is necessary to calculate in each case the location of the power transpositions. While observation does not indicate that it is strictly true, it is probable that for practical purposes the inductive effect of the power circuit on the telephone circuit, length of exposure remaining constant, will vary as the square of the separation, and the location of the power transpositions, where the exposure varies in separation from one end to the other, should be calculated with this in view.



STEEL TRANSMISSION TOWER.

It is, of course, evident that transposition of the power wires is effective only under conditions of perfect balance. If the three phases vary appreciably under normal conditions in potential, a transposition scheme such as has been suggested would be useless. Further, in the event of the grounding or opening of one or two of the phases the transpositions are also useless. Just what variation in potential may be expected under working conditions we should be interested in knowing, as we have been inclined to attribute the disturbance, due to several exposures, in a measure to this cause.

We have had occasion in a number of cases to observe that the disturbance is more pronounced and somewhat different in character where the exposure is to a three-phase circuit, operated with a Y-connection and a grounded neutral, than to a circuit operated with a Delta connection or a Y-connection with the neutral ungrounded. It is readily possible to note the difference between a disturbance

caused by a frequency of say, 60 cycles, and that by an appreciably higher frequency. In the discussion which followed a number of papers on the Grounded Neutral, presented before this Institute recently, Dr. Steinmetz called attention to the fact that with a grounded neutral effects were frequently set up which gave rise to an E. M. F. between the three phases and ground of triple frequency. This E. M. F. he describes as existing between the line and ground, and states that it may cause a rise in potential to ground above the normal value of as much as 40 per cent or more. Further, it is stated that currents of triple frequency are also caused to flow over the three line wires and return through the neutral. Assuming this to be true, the condition is evidently a serious one, as we have the equivalent of a single line, the three lines considered as one, with a ground return. It is evident that transposition of the power circuit is here quite useless. Further, both electro-static and electro-magnetic induction may both enter largely into the establishment of the difference in potential between the telephone circuit and earth, the E. M. F. causing this as described in the first portion of the paper, and the current also entering, due either to the difference in distance between the telephone circuit and power wire and telephone circuit and ground, or the tendency on the part of the current to follow paths other than directly beneath the circuits, and thus because of the lack of current density and consequent weakening of the field, the return current exerts an incomplete neutralizing effect. It is, of course, of little consequence whether the difference in potential between telephone line and earth is caused by electro-static or by electro-magnetic induction, but that this difference in potential is established is certain, and it seems not improbable in the manner suggested in this instance by both electro-static and electro-magnetic induction.

We have quite recently had an experience wherein certain of our circuits had been paralleled for some years by a 15,000-volt transmission system at a separation varying from 10 to 60 feet for a distance of approximately 12 miles. The total length of telephone line was in the neighborhood of 70 miles, and the exposures occurred at rather widely separated sections. Until such time as the grounded neutral was used on this system the inductive effect was unnoticeable. Immediately, however, upon placing in service in multiple with this transmission line, a plant operating with a grounded neutral, the disturbance became such as to render certain of our lines absolutely uncommercial. The high pitch of the disturbance was most noticeable in this case.

In the first part of these remarks the statement was made that on lines where inductive trouble was being experienced, difference in potential to earth varying between about 80 and 750 volts had been noted. That under ordinary maintenance conditions potentials of these magnitudes will in general cause considerable annoyance and under certain conditions, render transmission impossible, we know from experience. The existence of such potentials has on several occasions been questioned, and attention has been called to the fact that an ordinary alternating current voltmeter will not register it. This is a fact, but the explanation is simple. The introduction of an alternating current voltmeter of ordinary resistance partially destroys the air condenser, and values registered by the instrument are frequently not over 10 per cent of the total value. This point was brought out quite clearly by a series of experiments that we had occasion to make several years ago.

Between a particularly exposed telephone loop and ground a 16-candlepower 110 volt lamp was first placed. The lamp glowed dimly, and it was estimated that about 0.2 amp. was flowing. Next, a 2,100-ohm. Weston alternating current voltmeter of the dynamometer type was cut in series with the lamp. The voltmeter registered to 125 volts, but was thrown off the scale. The lamp glowed just as before, indicating the same flow of current through the additional resistance. Next, 5,000 ohms. (non-inductive) was placed in series with the voltmeter. Under this condition the voltmeter registered 122 volts, and by considering the non-inductive resistance as a multiplier to the voltmeter, the line voltage is fixed for this arrangement at 411 volts. Additional resistance was by steps cut in series with the voltmeter until the final voltage under these conditions indicated 610 volts. I say the final voltage under these conditions, as it then seemed evident that this method of measurement was an improper one. In addition to this, it was discovered that there was a limit to the available resistance. Subsequently, a series of tests were made by alternately charging a standard condenser from the line and discharging it through a Ballistic galvanometer. Readings on either side of the center of the galvanometer scale were taken, but only the highest figures were considered. The same condenser was then charged from a battery of known potential and discharged through the same galvanometer, and the two sets of readings compared. This indicated a maximum potential of 730 volts. Similar tests have on other occasions been made, using a standard condenser of one-third manufactured capacity, and an ordinary Weston direct current voltmeter. The voltmeter is, of course, merely used as the galvanometer in the former case, and the deflections, therefore, bear no particular relation to the scale readings.

Probably one of the most pertinent questions that can be brought up is: "With a given length of exposure just what separation do we consider essential when paralleling a high potential lead of a given voltage?" Though it may at first sight appear simple, I doubt very much if today even a reasonably definite reply to such a question could be made. With respect to the telephone circuit, so very much depends upon the condition of the line throughout its entire length, the amount of open wire, amount of cable, kind of cable, type of terminal apparatus, type of central office equipment at terminal stations, transmission equivalent of the entire circuit, number of wires on the lead, general importance of the lead, the possibility of its future importance, whether or not phantom circuits are being operated at present or whether or not they are contemplated in the future, and an almost indefinite number of other points, all of which would have an effect upon such a decision. In the first portion of these remarks attention was called to some of the principal points to be decided with respect to the power lead.

There are two other points that I wish to bring out with respect to inductive trouble that are generally admitted to be rather important. The first of these is the fact that the circuits composing our main toll leads frequently cover considerable territory, but that they are usually finally concentrated on one route. It is, therefore, quite possible for a relatively unimportant toll circuit exposed to a high potential line at some point in its length to, by secondary induction, affect a whole lead, many of the more important circuits in this way suffering from the effects of this apparently unimportant exposure.

The second point, and one of the utmost importance to telephone companies operating an extensive toll plant, is the phantom circuit situation. Wherever the margin of transmission is sufficient, preferably on two similar adjacent circuits, it is possible to obtain a third circuit by using for each side of the third circuit, the two wires of each of the metallic circuits in multiple. This is accomplished by means of specially balanced repeating coils, placed one at each end of each of the two metallic circuits. The third, or phantom circuit, is taken off from the mid points of the secondaries or line windings of these repeating coils.

I believe we may almost positively say that wherever inductive trouble is being experienced, even though we are able to operate physical circuits commercially, a phantom will prove absolutely inoperative. The reason for this seems fairly clear. As the phantom circuit has twice the exposure of a physical circuit, and approximately twice the chance for leakage or capacity unbalance, the foreign current through the terminal apparatus should be approximately four times as great as upon either of the physical circuits forming it. That the inductive effect upon phantom circuits is great, experience has proven. Wherever it is possible to do so, there is little question of the economy of phantom circuits, as by this means additional circuits can be obtained at but a small fraction of the cost of additional physical circuits. The inability to phantom physical circuits because of high potential exposures involves a serious loss of revenue or unnecessarily heavy expenditures.

It would, perhaps, be impossible to emphasize too strongly the desirability of commercial telephone lines being as far removed as possible from all sources of foreign electrical interference, and most particularly from high tension transmission circuits. There is little reason for becoming unduly enthusiastic over this point, however, as it is certain that under some conditions exposure to high tension circuits will always exist.

Admitting, however, that the situation is a bad one, and should not exist if there is any possibility of avoiding it, let us see what curative, or at least palliative, measure may be considered. The first is, of course, increased separation as the effect varies approximately as the square of the separation, length of exposure remaining constant. The next should be the transposition of the power lead as described previously. This is probably least effective where the power circuit is operating with a grounded neutral. Another means is the paralleling of the telephone circuit with a grounded wire or wires, which tends to increase the capacity of the loop to earth and thus reduce the difference in potential between loop and earth in accord with the previously advanced theory that the difference in potential of the telephone loop and earth is dependent upon the capacity between telephone loop and power circuit and telephone loop and earth, and that the capacity between telephone loop and power circuit remaining constant, its difference in potential to earth will vary inversely as its capacity to earth. The paralleling of a telephone circuit with grounded wires is, of course, a rather expensive expedient if the exposure is of considerable length and is in the case of a heavy lead frequently impossible. It must also appear that in most cases this expedient is highly impracticable. There is still another means which may occasionally be employed if the margin of transmission is sufficient, and that is, the isolation of the section of telephone loop opposite the exposure by means of repeating coils. The potential is evidently impressed at the exposed section only, but the current may leak to ground from one side more than from the other side of the loop at any point on the line. The isolating of the exposed section limits the possibility of an unbalanced condition of the loop to this section, and permits of both careful original insulation and balancing and careful future maintenance of this section. Further, it in a measure prevents the line or lines at the exposure transferring by secondary induction the disturbance to other circuits which they may later parallel. A scheme of this sort is, however, seldom to be recommended, as it introduces transmission losses which cannot usually be justified, and that are frequently sufficient to render the line uncommercial when its equated length approaches the commercial limit of about 30 miles of Standard cable. It is probably appreciated that a properly engineered telephone toll line contains no more copper than is necessary to bring the transmission within a certain limit, and that anything tending to increase its equated length means either a loss of revenue because of its unsatisfactory operation or an increased expenditure in order to increase its transmission efficiency. The engineering problem in long distance telephone transmission is, of course, to so design the line, switching and terminal apparatus that a predetermined quality of transmission will result with a minimum ultimate expenditure. This is frequently impossible, if, after laying out and constructing long distance circuits, factors other than those originally considered arise.

The rapid extension of both high tension circuits and telephone lines on the Pacific Coast in particular renders an earnest and early consideration of the problem of inductive interference to long distance telephone service a most important one.

These remarks are admittedly most incomplete, but all that they are intended to accomplish at this meeting is to call attention to the genuine seriousness of the situation and to request the co-operation of operating high tension engineers whenever the occasion arises.

The discussions on this paper will appear in the issue of May 30, 1908, "Journal of Electricity, Power and Gas."

TELEPHONE TROUBLES.

Can hear, but cannot talk: Cause—Primary circuit open.

Speech indistinct with a bubbling, buzzing sound: Cause—Loose connection at microphone.

Rings other bells feebly but its own bells strong: Cause—Generator weak or armature adjustment bad.

Bell rings frequently without apparent cause: Cause—Swinging cross with telegraph or other lines.

Spluttering or grating noise in telephone receiver: Cause—Loose connection at battery, transmitter, or hook.

Rings other bells strong but its own bells weak: Cause—Ringer magnet weak or armature adjustment bad.

Receives a ring but will not ring its own bells: Cause—Wire broken in generator or armature short circuited.

Can ring, but can get no response: Cause—Line badly grounded or broken and grounded, if bridged line open.

Rings, but cannot talk: Cause—Broken cord, bad connection, or hook does not go up to place, line open if bridged.

Speech received is strong, but transmitted is weak: Cause—Speaker stands too far from telephone or the battery is weak.

Cannot ring or receive a ring: Cause—Wire broken in office or line, short circuit if bridged metallic, grounded if bridged to ground.

Bell will not ring: Cause—Broken wire in bell box, line or ground wire, short circuit if bridging is metallic, or grounded if bridged lines.

Receiver weak: Cause—Bad connections, diaphragm bent or dirty, position of diaphragm not correct (should be 1/32 inch from magnet), or permanent magnet weak.

Receives and transmits a ring feebly: Cause—Bad connections in bell box or poor ground, resistance cross if bridging metallic, resistance ground if bridged grounded line.

Two bells ring together or two switchboard-drops fall: Cause—Office wires or line wires crossed if on common return wire, return wire broken, or annunciator ground broken.

EVOLUTION OF CAST-IRON PIPE.*

(Continued.)

Life. In these days, in selecting pipe for underground service, the engineer naturally turns to cast iron pipe as the most durable. While we do not know when pipe were first cast, there are well authenticated instances of cast iron mains in service to-day, which were laid more than two hundred years ago, and such pipe have now been in general use more than one hundred years. In 1901, at Versailles, France, an acquaintance of the writer saw repairs being made to a line of cast iron pipe leading to one of the palace fountains, which probably had been laid more than two hundred years. It is said that these pipes were put down in 1685. The fracture, due to subsidence, showed inside a clean pipe of good gray iron, but little rusted outside; the natural result with good water and subsoil conditions. In London, the first cast iron pipe we know of for water were put down about the year 1800. The eight London undertakings–the great water companies–are now vested in the "Metropolitan Water Board," and in a recent letter the Chief Engineer, William B. Bryan, Esq., writes: "As chief engineer, for many years, of the late East London Company I have had numerous opportunities of seeing old mains that had been in use for ninety years, and which, when taken up, were in perfect condition." In this country cast-iron pipe have been used for fully one hundred years. Some of the earlier pipe were imported, but the making of cast-iron pipe received early attention, and the industry has now grown to large proportions. In Philadelphia, following the use of bored logs, cast-iron pipe were first used about the year 1804, and since 1820 have been exclusively used by the water department. Numerous instances might be cited of pipe in use to-day which were laid more than a century ago, all tending to prove the long life of cast-iron underground. Thus, cast iron as a material has long been accepted as the standard for underground mains, and it is not surprising, therefore, to find cast-iron water and gas mains used almost exclusively in the cities and towns of this country and Europe.

"LOG PIPE." BORED LOGS LAID IN PHILADELPHIA BEFORE 1820.

Length.—In the early stages of the cast-iron pipe industry, short-length pipe were made; in France, about one meter in length; in England, about thirty inches; then came longer lengths, six and nine feet. The earlier joints were usually flanged, and these being found to be too rigid, were shortly followed by other forms, from some of which were evolved the turned and bored socket and spigot, similar to those to some extent to-day used abroad, and these in turn have been largely superseded by the standard bell and spigot joint calked with lead. Thus experience gained from the earliest days in the making and use of pipe has developed our present lines, as indicated by Standard Specifications as adopted or proposed by the leading manufacturers and the several water works and gas light associations throughout the country, which cover pipe cast vertically in dry sand, in lengths to lay twelve feet, with standard forms of bell and spigot.

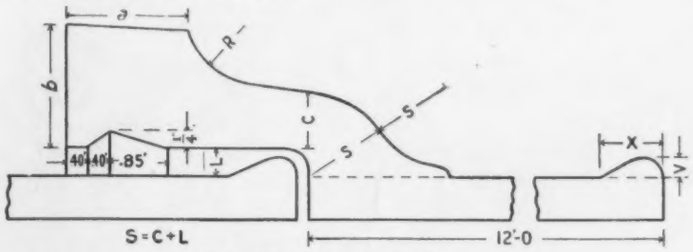
*Contributed by R. W. Martindale.

Dry vs. Green Sand Pipe.—In casting pipe vertically in dry sand, the use of core chaplets is avoided, and the twelve-foot length insures a much smaller number of joints in the main as compared with short-length green sand pipe which are cast on the side, "on the bank," in nine and six feet and even shorter lengths. Aside from the greater number of joints resulting from their use, these green sand pipe are liable to be of uneven thickness, and also to leak through imperfections in the pipe shell, which are due to the process, such as blow holes, or which result from the use of anchors to support the cores in casting on the side. These anchor spots are sometimes concealed by bosses or knobs, which form but a thin covering; thus, covered up, these defects are hard to discover, and often withstand the pressure test, but when buried in the ground will sooner or later develop leaks, or even cause the pipe to break. Such pipe, also, are usually of light weight with thin walls, are illy adapted to permanent mains, and form anything but substantial construction. The thin pipe shell will easily break under shock or subsidence, and the metal in the pipe, because of the process, has a tendency to hardness and brittleness. It is because pipe cast vertically in dry sand are so markedly superior, that the leading manufacturers of cast-iron pipe have some time since abandoned the manufacture of green sand pipe.

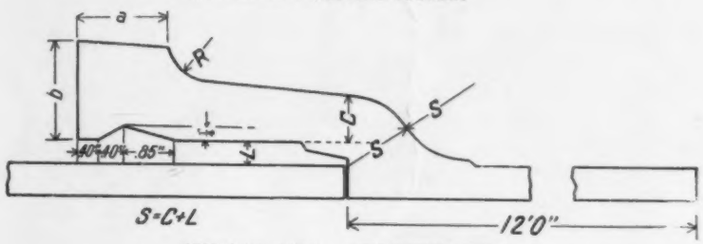
THREE LINES OF 60-INCH CAST IRON PIPE.

Joints.—In the operation of water and gas works, engineers are now more concerned with the question of leakage, and to reduce it, one or another form of joint has been tried, the bell and spigot being that now most generally used. This is because the bell and spigot joint, when well made, is the most flexible, allowing for expansion and contraction without affecting its tightness. Such joints are safely used in high pressure fire line pipe and other hydraulic pressure mains. We also show another type of bell and plain end pipe joint which is made up and calked with lead in the usual way. This design is used abroad and is substantially the same as is required by the Public Works Department of the Netherlands, at The Hague. It is claimed the plain end is more easily centered in the beveled bottom to the bell than is the ordinary spigot, and that the bevel in the bell more satisfactorily makes up with cut pipe. As to the turned spigot and bored bell joint, it is claimed that in being practically a metallic joint it does not leak unless it is broken through subsidence of the ground, or through accident. To allow

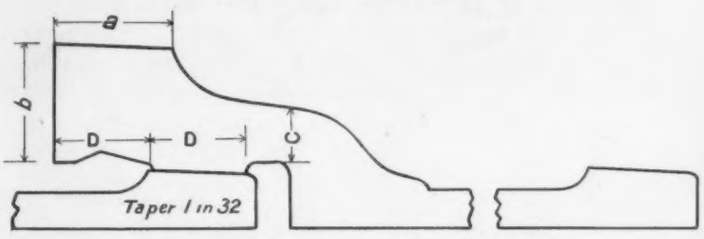
for expansion and contraction, some engineers for every tenth joint use a socket and spigot calked with lead, while others claim to have no trouble on this account, no doubt because of location. For underground service, a bolted joint, whether flange or of other form, should be avoided as too rigid, and because the bolts are liable to rust. An iron to iron joint, whether of conical or ball type, is in no sense a flexible joint, but is liable to rust fast in whatever position it may be laid. There is nothing new in such joints, as certain old French and other patents will testify. If an iron to iron joint is preferred, it should be of the turned and bored type, without bolts.



STANDARD BELL AND SPIGOT.



BEVELED BELL. THE DUTCH TYPE.



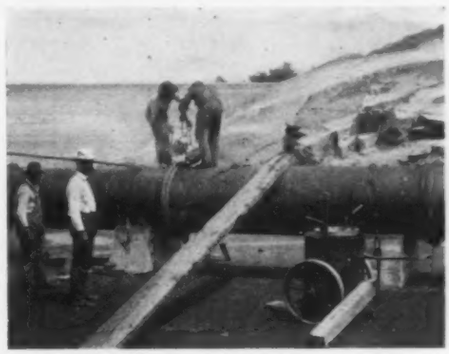
STANDARD BORED BELL AND TURNED SPIGOT.

Making Joints, Bell and Spigot.—In laying cast-iron pipe having bell and spigot joints calked with lead, care should be taken in making the joint to wrap sufficient yarn around the spigot before entering the bell, then to pack it in with calking tools before running the lead, which should then be well calked up against the yarn. On well-laid water mains of cast iron, a leaky bell and spigot joint is extremely rare. Some of our friends claim that they do not have any, and recently, an engineer in a prominent Eastern city, advised of having uncovered last year several miles of cast-iron bell and spigot water mains without finding a single leaky joint; evidently these lead joints were well made. Note the photograph of a 48-inch cast-iron bell and spigot main, near Lardner's Point, Philadelphia, as under pressure it was being shifted to one side, and afterward raised onto the ledge. During the shifting of this line of 48-inch pipe, the regular water pressure of sixty pounds was not turned off, and the only evidence of leaks at the leaded joints was a seepage readily stopped by recalking when necessary. To do this was a severe test of the bell and spigot joint, as to flexibleness and tightness.

Bell and Spigot Joints, in which, instead of lead, the socket in the bottom and annular space surrounding the spigot is filled with wood and carefully calked, have proven tight, and are thought to so insulate the joint as to materially lessen, if not prevent, electrolysis. It is too soon to speak of this assuredly, but encouraging results are said to have been obtained within the past year with joints so made.

Turned and Bored Joints for water or gas pipe, as used abroad, are rapidly laid and are perhaps more extensively used for water than for gas. This general type of joint is still exclusively used in many prominent foreign plants, while it is scarcely used at all in the United States. We again quote from another recent letter from William B. Bryan, Esq., Chief Engineer, Metropolitan Water Board, London:

"In my own practice I have used immense quantities of turned and bored pipe, and I certainly think that these pipe, where streets are straight and there are no obstructions to cause deviations, have very great advantages. The greasing of the joints and placing them gently into the sockets of the next pipe, and centering them perfectly, makes a joint which is practically water tight of itself, but in all cases the socket is run with molten lead and set up in the usual manner." In making joints for gas, red lead or sal ammoniac is used and the pipe driven together, in some instances, without running in the lead and calking; but where this is done the joint is so designed, that in case of a leak it may readily be calked with lead or made good with cement. With turned and bored pipe we supply special castings of our standard dimensions, with bored bells all around. While without the use of special curves the turned and bored joint pipe may only be laid in straight lines, very often long or easy curves are made in lines of full-length bell and spigot pipe. An instance of this is shown in the photograph. A slight adjustment in the bell when laying is possible in the standard bell and spigot joint.



POURING A LEAD JOINT.

48–INCH CAST IRON MAIN MOVED WHILE UNDER PRESSURE.

(To be continued.)

THE JOURNAL OF ELECTRICITY POWER AND GAS

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

111 New Montgomery St., San Francisco, California

E. B. STRONG, President and Gen'l Manager

A. H. HALLORAN, Secy. and Managing Editor

Directors:

R. J. DAVIS, A. M. HUNT, E. M. SCRIBNER, C. L. CORY, E. B. STRONG

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Canadian subscription $3.50. Foreign subscription, $4.00.

Subscriptions cannot be begun with back numbers. Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.

Entry changed to "The Journal of Electricity," September, 1895.

Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

VOL. XX MAY 23, 1908 No. 21

EDITORIAL.

THE TELEPHONE EDITION.

This issue of the "Journal of Electricity, Power and Gas" is, in a measure, typical of the proposed Telephone Edition to be published in the second number of each month, commencing during July, 1908. For fifteen years past the "Journal" has chronicled telephone news west of the Rocky Mountains, together with occasional descriptive and technical articles. These will hereafter be segregated to appear monthly, not only for the benefit of our regular readers, all of whom are telephone users, but also for telephone specialists.

The editorial stand will be independent and unbiased. Recognizing the great possibilities for telephone development in this Western field, we are preparing to exploit them by telling the world precisely what is being done. New telephone installations which are noteworthy, either in point of size or because of unique features, will be described in full, and accounts of new apparatus, new patents, and other pertinent data, together with articles that will be interesting to both the layman and engineer, will be published. A practical telephone man will take charge of this bureau. He will be able to answer the many questions that arise in connection with telephone work and will be willing to tell what he has learned during many years of experience. The aim will be to relieve the dull tedium of purely technical articles by live matter of general interest.

TELEPHONE DIFFICULTIES.

Complacently engaged in substituting cable for wire, experimenting with concrete poles, investigating duplex systems, designing satisfactory subscriber's instruments, installing automatic ringers, and putting in service meters, the telephone engineer has been rudely awakened by the fact that his most perfect systems are being made inoperative because involuntarily forced to act as transformers for near-by high-tension electric power circuits. The telephone field may be likened to a peace-loving citizen, who has nicely settled himself in a quiet, sunny cottage in a beautiful suburb, which is suddenly recognized as an ideal manufacturing site. Succeeding the din of construction are noise and dirt, which he must endure either until ameliorating regulations reduce them, or until he is forced to abandon his home. If the owner lives in the same neighborhood, the former is the more likely alternative. Fortunately the same thing is true of the telephone situation, and insomuch as power companies are themselves the most seriously affected telephone users, they are likely to devote all their energies to remove the difficulty.

In this issue Mr. Elam Miller calls attention to the "Inductive Interference with Telephone Circuits in Proximity to High Potential Transmission Lines." He shows that with the increased potential and more general application of the electric current for power and light, satisfactory telephone service is becoming more and more difficult. Already mere transposing or spiralizing of the telephone lines have proved insufficient and various counteracting devices but little better, as a means of equalizing the potential. In the mathematician's parlance it is difficult to establish a differential suitable for typical integration. Because of electro-static and electro-magnetic induction, telephone wires are rendered unfit for transmission of conversation.

Having shown that his troubles are due to the power lines, the telephone engineer naturally looks to their designer for aid. As palliative measures he has paralleled telephone circuits with grounded wires and has put in repeating coils to isolate exposed sections. But while these may be all right in theory, in practice they are not wholly satisfactory on account of the great expense of the former and the transmission losses of the latter method. Consequently he proposes that the power circuit be transposed in order to minimize the difference of potential between the two sides of the telephone loop and ground. This in itself is an excellent suggestion wherever the grounded neutral is not employed. In the discussion that followed (which will appear in our next issue) representatives of the power companies showed that much of the trouble was due to grounding and leaks, which could be avoided by better attention to the line.

But until these various improvements can be perfected, common sense would suggest divorce as the best solution of the problem, alimony to be eliminated and priority to govern occupation. In other words, neither a power nor a telephone line should be allowed to parallel the other within a distance of say sixty feet, which may be assumed to be a safe limit. Nor should either be forced to bear the burden of the expense. In long distance transmission, power lines seldom parallel the commercial telephone lines, and in distribution mutual co-operation will accomplish far more than opposition.

PUBLICATIONS RECEIVED.

"Telephone Construction, Installation, Operation, Wiring and Maintenance," by W. H. Radcliffe and H. G. Cushing, has been recently issued by the Norman W. Henley Publishing Company, of New York City. This book is intended for amateurs, wire men, engineers and contractors desiring to make local telephone installations, being written in simple language without intricate mathematical terms. After an elementary description of the common forms of receivers, transmitters, batteries, and other details of telephone instruments, the authors describe wiring methods for different kinds of installations. The following chapters on inspection and maintenance of telephone instruments are particularly valuable. All the details of telephone line wiring are illustrated by drawings and diagrams that give a quick understanding of the subject. The remaining chapters are devoted to tests of telephone line work and cables, and the wiring and operation of special telephone systems. The book contains 170 pages and is well bound. It will be sent postpaid for $1.00 by the Technical Publishing Company.

"Tables for Engineering Calculations," by Richard C. Powell. A second edition of this valuable compilation has been reprinted and contains enough new matter to nearly double its former size. It contains a collection of formulae and tables for nearly all engineering calculations; descriptions and illustrations of the apparatus having been omitted. This includes tables of logarithms, trigonometrical functions, circles, functions of natural numbers, conversion units, and other mathematical tables. There are few requirements of the civil engineer that have not been met. Standard tables upon heat are all that have been given specially for the mechanical engineer. Magnetic, electrical and transmission line constants, including the necessary data for wiring and cables are available to the electrical engineer. The data on hydraulics is particularly valuable. It is difficult to criticize a book of this character, because it is impossible to include in one volume of 200 pages what is needed by every engineer. The author has shown great discrimination in his selections. The book is handsomely bound in flexible leather and will be sent postpaid for $2.00 by the Technical Publishing Co.

MEETING NOTICE.

"The Horn Type Arrester Automatic Circuit Breaker" will form the subject for discussion at the meeting of the San Francisco section of the American Institute of Electric Engineers, 8 p. m., May 29, 1908, Franklin and Ellis Streets. Mr. A. J. Bowie will present a paper on this subject, which will be discussed by local engineers.

TRADE CATALOGUES.

The Jandus Electric Company, of Cleveland, Ohio, send a handsome pamphlet illustrating and describing Daniels' boulevard lighting system.

PERSONALS.

George A. Scoville, San Francisco engineer of the Dean Electric Company, of Elyria, Ohio, is making an extensive trip throughout the Northwest.

Jos. R. Mathews, electrical engineer for the Northern Commercial Company, of Fairbanks, Alaska, has left for Seattle after a three weeks' stay in San Francisco.

J. E. McGillivray of the American Electric Telephone Co. returned this week from a five weeks' trip through Washington, Oregon, Idaho and Utah, and reports considerable activity in the construction of new telephone lines and plants throughout the country.

Mr. Richard Spencer, manager of the California Electric Company, of Los Angeles, is in San Francisco for a few days. He has just returned from a two months' business and pleasure trip through the East, and reports that conditions in that section show continued improvement.

C. G. Vickery, formerly general superintendent of the Utah Independent Telephone Co. at Salt Lake, has recently resigned and returned to Rochester, New York. He is succeeded by Fred B. Jones. Mr. Jones was formerly superintendent of construction and has been identified with the plant since its inception.

Mr. Eben C. Dodge, president and general manager of the Battery Supplies Company, manufacturers of Gladstone La-Land batteries, Newark, N. J., has just reached San Francisco from Los Angeles, in the course of a trip taking in the Pacific Coast. This is Mr. Dodge's maiden visit to the coast, and he is greatly impressed with the vast amount of work which has been accomplished in the reconstruction of San Francisco.

After serving a little over two years as treasurer of the California Electrical Works and assistant treasurer of the Western Electric Company at San Francisco, R. W. Van Valkenburgh left for the East on May 15th to take up his duties in a more responsible position with the latter company at Chicago. Mr. Van Valkenburgh established himself in San Francisco a few days prior to the great disaster of 1906, just in time to undergo the test of fire that followed, and that he acquitted himself with credit in the complex work of reorganization is a matter of record. By his sterling honesty

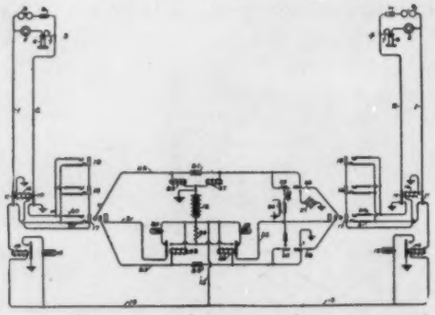
R. W. VAN VALKENBURGH.

and just methods he quickly made for himself a recognized position among credit men on the Pacific Coast generally. The great interest shown by him in the Electrical Trades Association and the time he devoted to the work of that organization resulted in his election to the vice-presidency, a position with which he was twice honored and which he occupied up to the time of his departure. The large circle of friends, both personal and business, formed during the brief two years he was with us join in congratulations on this well-merited recognition of his ability and best wishes for his future success.

PATENTS

THREE-WIRE CENTRAL-ENERGY TELEPHONE SYSTEM. 885,186. Charles A. Simpson, Chicago, Ill., assignor to Kellogg Switchboard & Supply Co., Chicago, Ill.

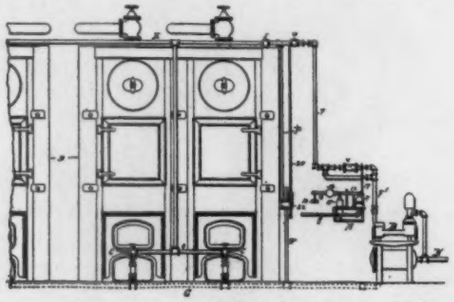
In a telephone system, the combination with a pair of telephone lines, of a cord circuit for making connection therewith for conversation, a third conductor at the central office isolated from the talking circuit, a cut-off relay in said conductor associated with the line, a supervisory signal in said conductor associated with the cord circuit, a pair of terminals in the talking circuit normally disconnected from the line at the contacts of said cut-off relay,



an impedance coil, a central source of current and a supervisory relay in a bridge of the cord circuit, a normally-open low-resistance branch circuit about said signal, and means operative in making connection with the line for completing the talking circuit through said terminals at the contacts of said cut-off relay, said supervisory relay being energized over the telephone line and said impedance coil, and being adapted to open the circuit of said signal and close said low resistance branch when the subscriber's telephone is in use.

SYSTEM OF REGULATION FOR OIL-BURNING PLANTS. 886,466. James R. Atchison and Clarence R. Weymouth, San Francisco, Cal.

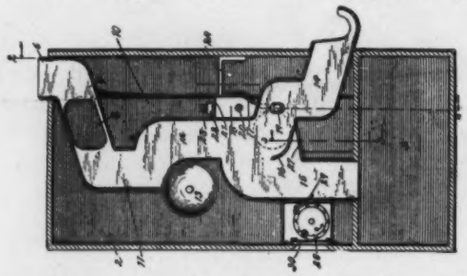
In a system of regulation for liquid fuel-burning plants, a liquid fuel burner adapted to receive a continuous flow of liquid fuel and a continuous flow of an atomizing agent, means for varying the supply pressure of said liquid fuel and thus the rate of flow of said fuel through



the burner, and means controlled by the variation of said liquid fuel pressure for automatically governing the supply pressure of said atomizing agent and thus the rate of flow of said atomizing agent through the burner and producing a continuous flow of said atomizing agent, the said governing being independent of a commingling action of said fuel and said atomizing agent.

SYSTEM AND APPARATUS FOR TELEPHONE LOCAL TOLL OR PAY STATIONS. 886,497. James Harrison, St. Louis, Mo.

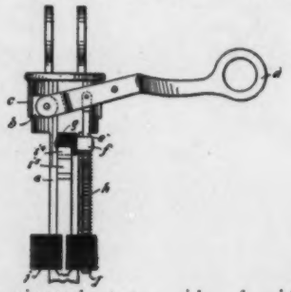
In a coin collecting or pay station for telephone systems, the combination with a supporting member in the line of movement of the coins for receiving the impact of the coins and to suspend the first coin in position to effect the deposit of succeeding coins into a suitable depository,



and means associated with the supporting member for holding the coin thereon and which when moved permits the suspended coin to pass from the supporting member and be refunded.

TELEPHONE-HOOK SWITCH. 885,348. Herbert L. Knight, Cleveland, Ohio, assignor, by mesne assignments, to Century Telephone Construction Company, Buffalo, N. Y.

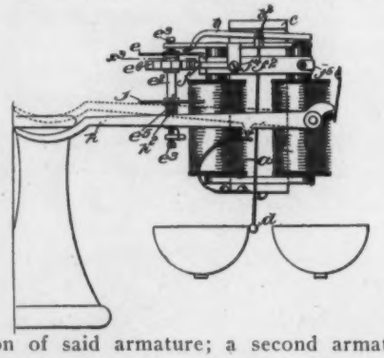
In a telephone hook switch of the class described, the combination with a tubular casing, of a telephone-support-



ing switch hook pivoted at one side of said casing, an ingangue over the side, in combination with a driving shaft, a secondary shaft imparting a direct reciprocating motion to the table independent of lateral motion, means for transmitting motion to the secondary shaft, an auxiliary shaft, and an independently adjustable arm connected therewith and with the table for imparting lateral motion to said table.

TELEPHONE SYSTEM. 885,270. Frank E. Mayberry, West Medford, and Newman H. Holland, Brookline, Mass., assignors to Boston Telephone Selector Company, Boston, Mass.

In a signaling system, an electro-magnet provided with a polarized armature and a signaling device operated by the vibration of said armature; means for preventing

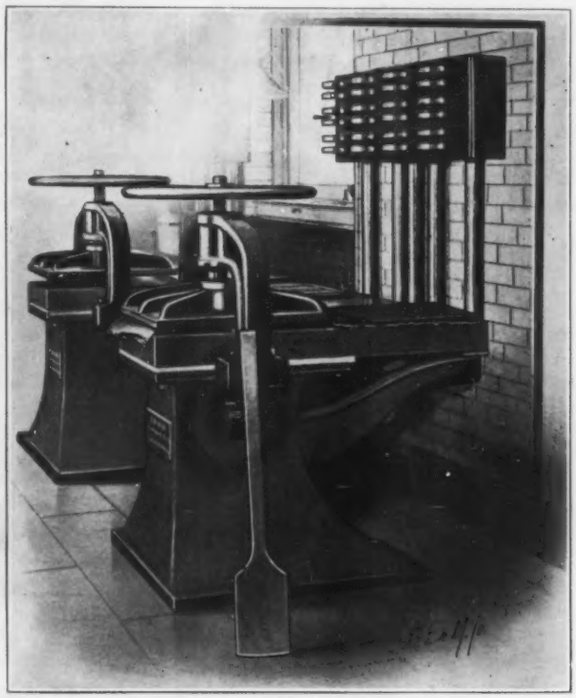


the vibration of said armature; a second armature in the field of said electro-magnet adapted by its movement to operate the means for preventing the vibration of the polarized armature; a third armature to control the restoring of the preventing means to normal; and means for energizing said electro-magnet by direct currents and by alternating currents.

INDUSTRIAL

ELECTRIC HEAT APPLIED TO STEREOTYPING.

A striking example of the advantages of electric heating over steam or gas heating is afforded by the Hadaway electrically-heated stereotypers' matrix drier. The stereotyping process in every newspaper office is one in which the time element is of the greatest importance. Every minute counts and much experimenting at great expense has been undertaken for the sake of reducing the time. With the other methods developed to the utmost, the electric method shows a saving in time of from fifty to sixty per cent.



STEREOTYPERS MATRIX DRIERS.

In addition to the saving in time, the Hadaway matrix drier presents a number of advantages over the older types. The bed which contains the heating element is solid and has no tendency to give like the cored bed required by other methods. The liability of the bed to explode from excessive pressure is entirely eliminated. Electric heat can be more closely regulated and is absolutely reliable.

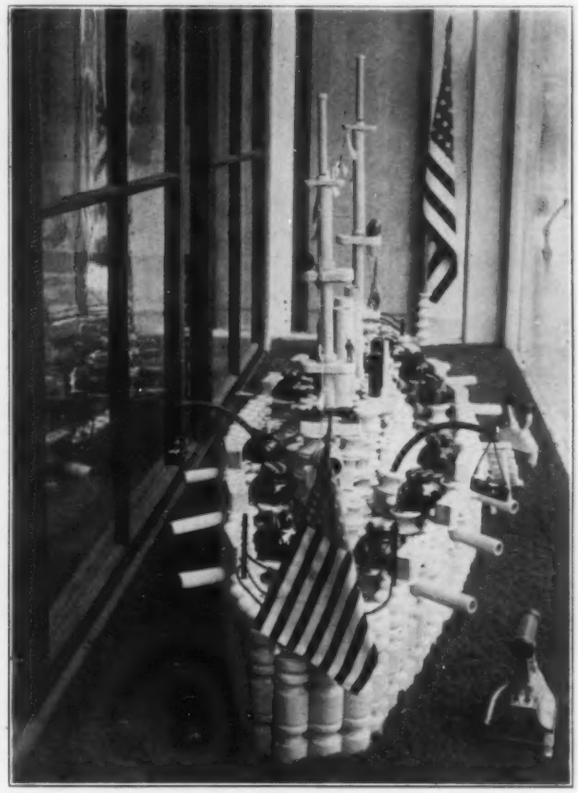
The heating element consists of a steel resistance grid, embedded and hermetically sealed in fireproof insulation in a heavy bed plate, immediately below its upper surface. As the result of this construction the surface of the bed plate attains a very high temperature and the solid metal below serves as a thermal storage reservoir. The cold form draws the heat very rapidly from this surface, so that the type is very quickly brought to the temperature required to thoroughly dry out the matrix.

The grid is practically indestructible. The fireproof insulation does not deteriorate when continually subjected to high temperatures. It has a high dielectric strength and good heat-transmitting qualities.

This device is manufactured by the Westinghouse Electric & Manufacturing Company.

BROOKS-FOLLIS PORCELAIN BATTLESHIP.

With the coming of the fleet and the resultant crowds the various San Francisco electrical supply firms prepared attractive window displays. Flags and ribbons waved to the wind of electric fans and variegated electric lights twinkled a warm welcome. But the picture on this page shows a vessel attached to neither the Atlantic nor Pacific fleet. It appeared in the window of the Brooks-Follis Co. and is constructed entirely of porcelain insulators. Close examination will reveal the ingenuity and patience necessary to assemble the parts. Incidentally it attracted much favorable attention to the various other lines of electrical supplies carried at the new store of the Brooks-Follis Co. at 44-46 Second Street, San Francisco.



PORCELAIN BATTLESHIP.

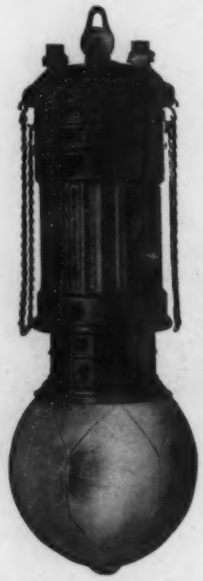
LUMINOUS ELECTRIC RADIATORS.

Luminous radiators consist of an ornamental cast-iron frame, fitted with a polished copper reflector at the back and with three or more large cylindrical incandescent heating lamps, and are described in an attractive pamphlet recently issued by the General Electric Company, Schenectady, N. Y. The source of heat is a small filament which becomes incandescent immediately, emitting a powerful heat from the moment the current is turned on, and as it radiates the heat directly it does not depend for its operation on setting up a current of warm air. The luminous radiator is thus distinguished from all other electric heaters which take an appreciable length of time to become effective. The pamphlet describes the uses and advantages of the apparatus and shows many illustrations of installations. It is of interest to all electric companies who wish to increase their revenue without additional distribution expense, as well as to architects and house owners.

A NEW FLAME ARC LAMP.

There has just been placed on the market by the General Electric Company a new flame arc lamp. The external appearance of this lamp is similar to the G. I. enclosed lamp, the casing being drawn seamless from either sheet copper or steel. The standard finish for the copper casing is "antique," and "bright japan" for the steel. This lamp has no chain feed or complicated escapement and clock mechanism. It is of the inclined carbon type, with nothing below the arc to obstruct the light, and both carbons feed by gravity simultaneously, while the regulation of the arc is accomplished by the lateral movement of one carbon to the other. When the casing is lowered into the trimming position, every part of the lamp becomes accessible.

A serviceable "economizer" of refractory material surrounds the points of the carbon just above the arc, so as to prevent the "washing" of the carbon ends, and to steady the arc from the effect of air currents so far as possible. A "blow magnet" is so situated with relation to the arc that it performs the double function of keeping the arc steadily fan-shaped at the carbon tips, and also totally extinguishes the arc if for



any reason it approaches dangerously near to the "economizer." The "economizer," therefore, is well protected from burn out and should last indefinitely. A heavy "baffle plate" of insulating material is provided just above the "economizer," effectually preventing any appreciable amount of the products of the arc from depositing on the parts of the mechanism. During operation the lower surface of the bottom plate of the lamp and of the economizer becomes coated with white deposit from the arc, which acts as an excellent reflector for the upward light from the arc.

These lamps are designed to burn two-in-series or singly across 100 to 125 volt direct or alternating current circuits. They can be used on any frequency between 40 and 140 cycles. The lamps may be wound for either 8, 10, or 12 amperes, the latter current being considered standard. All lamps are equipped with light opal globes.

The life of these lamps is about twelve hours on indoor circuits and between 10 and 11 hours on outdoor circuits. The simple construction, remarkably high efficiency, and the volume of illumination obtained from these lamps appeal to the operators of mills, wharves, warehouses, erecting shops, foundries, and other places where the quantity of light is as desirable as the quality.

THE COST OF PREVENTING BOILER SCALE

Some time since Dr. Arthur D. Little, Chemist of Boston, was called upon by one of his clients controlling a considerable number of boiler plants, to study the conditions therein with a view of standardizing the methods of preventing boiler scale and reducing the expense therefor. Obviously his report cannot be made public in its complete form, but, devoid of specific references, the following general abstract will doubtless prove helpful to better owners and operators:

In seven mills Mr. Little found soda ash and kerosene in use, either alone or in combination with each other, while in three mills a fume compound was employed. The price of the latter was 10 cents per pound, its approximate composition being

Water	28%
Insoluble Matter	9%
Sodium Carbonate	43%
Sodium Phosphate	13%
Organic Matter (Tannin)	7%

Another mill was using a special compound costing only 2¾ cents per pound with an approximate composition of

Alkali	14%
Insoluble Matter	5%
Water and Organic Matter	81%

Still another mill was using a compound at 6 cents per pound composed of

Water	10%
Soda Ash	53%
Common Salt	33%
Organic Matter	4%

It was found that all the mills in the combination which used special compounds were expending nearly $1300 per year for boiler compounds. Those which were using only soda ash and kerosene were expending very much less per horse power although practically the same water supply was provided.

The method of applying the soda ash was investigated, and it was found that in the case of a number of mills there was a mistaken idea of the use of a boiler compound. The methods employed in these mills, while differing somewhat in details, were to add the soda ash once a week and *clean the boiler*. The true method was shown to be to add the soda ash in small quantity and continuously, and then keep the boiler in a condition so that by frequent blowing off it is *kept clean*.

It was shown by Mr. Little that a considerable saving could be made and a better result secured, not only by reducing the cost of the compounds themselves, but by keeping the boilers in first-class condition and preventing the formation of scale, thereby reducing the amount of coal required to produce the desired amount of steam.

H. W. JOHNS-MANVILLE CO. IN DETROIT.

The business interests of the H. W. Johns-Manville Co. in the city of Detroit and the territory adjacent thereto have increased to such an extent that a new branch is about to be opened by that company. This branch will be located at 72 Jefferson Avenue, Detroit, under the management of Mr. Willard K. Bush. Mr. Bush is well and favorably known throughout that section of the country, having been connected with the Milwaukee branch of the company for a number of years. The company will carry a complete stock of goods at the Detroit branch, so that shipments can ordinarily be made direct from Detroit stock.

PALACE HOTEL WIRING.

John G. Sutton Co., 229 Minna Street, San Francisco, have been awarded the contract for wiring the Palace Hotel. This includes over 170,000 feet of conduit, panelboards, switches, receptacles for lighting, as well as the telephone and fire alarm systems. Including the extensive temporary installation, this work will cost about $60,000.

NEWS NOTES

TELEPHONES.

Seattle.—The petition of A. W. Davis for a telephone franchise at and near Rodondo Beach was granted.

Seattle.—The petition of B. B. Cox for telephone, electric light and water system in Loyal Heights. Hearing June 9th.

Miles City, Mont.—Construction on the Miles City telephone line, forty-four miles in length, will be commenced at once.

Salt Lake City, Utah.—The Tintic Mining Company, of Salt Lake, will install in some of their mines near Ogden, a complete mining telephone system.

Stinson, Ida.—The County Commissioners have granted a telephone franchise to the residents of this place to construct a telephone along the public highway near this vicinity.

Spokane.—The residents of Minto Park Addition have petitioned the Pacific States Telephone Company to install a telephone system. The company will consider the matter.

San Francisco.—The Board of Supervisors on May 18, by a tie vote, prevented the proposed ordinance for reduction in the existing telephone rates from passing to print.

Lewiston, Idaho.—It is expected that within the next sixty days work will begin in building a new telephone exchange to accommodate the Interstate Company, which is rapidly building toward Lewiston from Spokane.

Salem, Or.—M. W. Mahoney, President, and Alex Harold, Secretary, of the Salem-Fairfield Telephone Company, have filed a petition with the county court for permission to build a telephone line along the Salem-Champoeg road.

Vancouver, B. C.—Construction of the new trunk telephone line to connect the farming section of Dewdney municipality with the city of Vancouver has already begun and the line will run through Port Hammond and Port Haney, extending as far as Nicomen Island.

Wallace, Idaho.—Work has started on the construction of the new common-battery plant of the North Idaho Telephone Company at Wallace, Idaho. The switchboard will be of the lamp line signal, common battery multiple type with an ultimate capacity of 1,800 lines.

Newport, Wash.—R. S. Anderson, who was granted a franchise by this place recently, has reached the city. Mr. Anderson purchased the local exchange of the Pacific States Company. The system will be reconstructed, and the line extended to Metaline. About $10,000 will be expended.

Ilwaco, Wash.—W. H. DeVarney, general superintendent of the B. R. Electric and Telephone Manufacturing Co., of Portland, has secured the contract for putting in the new telephone line for the extension of the Ilwaco Railway Company from Ilwaco to Knappton, and will commence construction work as soon as material can be brought down.

Boise, Idaho.—It is reported that an independent telephone line is now being constructed from Elko, Nevada, to Mountain Home, and it is understood it will be extended from the latter place to Boise some time during 1908, which will give this city a direct line into the heart of Nevada. It is thought the exchange of the new system will be established here.

Sedro-Woolley, Wash.—The Skagit River Telephone and Telegraph Company has commenced the construction work on its line at Baker, and expects to complete it as soon as possible. It is intended to run the line from the Washington Portland Cement Company's plant through Baker, Superior, Hamilton and to this city, where it will connect with either the Sunset or Independent lines for long distance service.

Sumas, Wash.—A number of people of Upper Sumas, Abbotsford and Huntingdon met at the customs office of Fraser York, on the boundary line, and formed a telephone compay for Sumas and Matsqui municipalities. L. G. Van Valkenburg, local director for the Farmers' line in Whatcom County, assisted with the organization. It is the intention of the company to build lines in those municipalities where needed and connect with lines from Chilliwack and other municipalities to the west.

ILLUMINATION.

Fruitvale.—A. Hunse and others of this place are planning the erection of a gas plant which is to serve the suburban territory east as far as San Leandro.

San Francisco.—The engineer has been directed by the Board of Harbor Commissioners to prepare plans and specifications for an electric light plant on dredger No. 3.

Los Angeles.—The Loftus & Burnham Company, of Los Angeles, has acquired the townsite of Heber, on the Imperial Valley Branch of the Southern Pacific Railway, located midway between Calexico and El Centro. The company is making plans for an electric lighting system.

Beaumont.—The Beaumont Gas & Electric Company has signed a contract with the Western Boiler Works, of Los Angeles, for generators, shells, holders, and other apparatus for the Beaumont Gas Works. The Los Angeles Company was represented by Mr. Darby, who came to close the contract.

Woodland.—A. J. Munch, a Stockton contractor, has revived the speculation as to whether or not natural gas can be developed in sufficient quantity and at a cost to make the enterprise profitable. He compares conditions as to the fall of the country and the conditions of the soil with the country round about Sacramento and Stockton, and as they are similar, he expresses the confident opinion that there is an abundance of natural gas here, although he might have to go deeper than 2,000 feet to find it. He says that a 14-inch well would supply 50,000 cubic feet of gas every 24 hours, and that such a well could be sunk and all pipes laid for $15,000.

TELEPHONE.

John W. Fisher, general manager of the Interstate Telephone Company, Spokane, Wash., is acting as consulting engineer for the North Idaho Telephone Company, which has a number of exchanges under construction and in contemplation.

The Hermiston, Oregon, telephone plant was put in service last week. This system is a new departure in telephone exchange work, in that two, four, six, or eight telephones are placed at will on one line, and each telephone rings selectively, not disturbing the others. The patrons express themselves as being very much pleased with the service.

The contract for the new common-battery plant to be installed at Wallace, Idaho, by the North Idaho Telephone Company will be let within the next sixty days. The Stromberg-Carlson Company, the Dean Electric Company, and the American Electric Telephone Company will be the firms that will bid on furnishing the equipment.

Seattle.—The Board of County Commissioners granted a telephone franchise for Vashon and a portion of Maury Islands to H. Harrington, A. D. Cowen and J. W. Rickert, the life of the contract to extend fifty years. Permission was given by the Board to lay a suburban cable from a spot near Fauntleroy Cove to Dolphin Point, on Vashon Island, and thence along the beach from Dolphin Point. Permission is given to string wires and set poles in the county roads.

The Independent Long Distance Telephone Company, of Boise, Idaho, and the Interstate Telephone Company, of Spokane, are endeavoring to perfect arrangements for a through circuit for long distance between Spokane and Boise. A conference between the two companies will take place in Spokane this week to arrange the preliminaries. The Boise company now reaches as far north as Grangeville, and the Interstate company has a new line staked out as far south as Lewiston, where it has recently been granted a franchise for a local exchange.

San Francisco.—The telephone committee of the Board of Supervisors is about ready to report an ordinance fixing telephone rates. If the ordinance meets with the approval of the board, telephone charges and rentals in San Francisco will be reduced practically 10 per cent. The proposed reductions are not a flat cut, but in the aggregate it is figured that with the pruning to which the telephone company's schedule of charges has been subjected, the rates will still be large enough to return 6 per cent net on an investment of $6,000,000, at which figure the investigating committee has fixed for rate-fixing purposes the investment of the telephone company.

Callahan.—Those interested in incorporating the Callahan Telephone Company met here last week and formed a temporary association by electing F. A. Drant president and F. W. Armstrong secretary. A general discussion was had and plans submitted for incorporating the company and starting the construction of the line to Gazelle, a distance of 28 miles. All the residents along the public road between both points have signified their desire to have telephones in their residences, and this, in conjunction with the aid promised by the National Forest Service officials, assures the completion of the line at an early date.

The telephone operators at Boise, Idaho, employed by the Independent Long Distance Telephone Company, were the guests of the White Line Transfer Company the other night, and participated in an old-fashioned hay ride. The transfer company sent around a four-horse team with a big box on the wagon and plenty of hay. The line of march included the streets of the city, as well as a ride through the country. The "doings" included a plentiful supply of ice cream, other good things, and between times the rendering of a "telephone yell," which went like this:

"Who are? who are? who are we?
We're the telephone companee.
Independence is our boast.
Number, please? without a roast."

General Manager Charles J. Sinsel chaperoned the party and exerted himself to see that every one had an enjoyable time.

The telephone rates committee of the Board of Supervisors has submitted an ordinance so regulating the charges that may be made in this city and county during the coming fiscal year that the effect will be a general reduction of 10 per cent from the rates now charged. The proposed reduction in rates is to be effected partly by increasing the service to be given for charges left undisturbed, and partly by direct and in some instances radical cuts in other charges. One of the most important provisions in the new ordinance aside from the rates is that which allows telephone users maintaining private exchanges to select their own operators instead of compelling them, as may now be done under the existing form of contract, to employ such as the company may choose for them. This course is regarded as safeguarding the rights of girls who have fallen into disfavor with the company because of the recent strike, to obtain employment without regard to the wishes of the company. One of the direct reductions in charges ordered under the new ordinance cuts the ten-cent charge made for single switches at the ferry and other public exchanges to five cents. The other direct money reductions ordered under the new ordinance are as follows: For each trunk line connecting a private exchange with the company's exchange the rate, now $3.00, shall be reduced to $2.50. For one-party residence telephones, unlimited service, the present $5.00 rate is to be reduced to $4.00; two-party lines, $4.00 to $3.50. For each additional telephone connected with a private exchange and installed in the same premises, except in hotels, the monthly charge, now $1.00, shall be 50 cents. In hotels the extra charge is to remain as now, 25 cents a month. For each extension telephone on a residence or business line the maximum charge per month, now $1.00, shall be 50 cents. While the maximum charge for private line telephones remains $2.50 per mile per month, the rate for stations on such line is reduced from $1.00 to 50 cents. In making the reductions stated, the members of the Telephone Rates Committee have sought to so arrange the schedule that the company may obtain six per cent return on a total investment of $6,000,000, having, in figuring to this end, estimated that there will be a 20 per cent increase of business during the coming year, with a corresponding increase of but 7 per cent in expenses. The company's own estimate of its total investment is $6,496,596.

TRANSMISSION.

Eureka.—M. C. Hast, acting for the Crystal Water Company, has filed a notice of location of 15,000 inches of water in Jacoby Creek.

Turlock.—Notice has been given that T. J. Burrow, Jr., has applied for and will be granted a power line franchise in Stanislaus County.

Red Bluff.—Leon Bly has filed a notice to the effect that he has appropriated 10,000 inches of water in Mill Creek. The water is to be used for power purposes.

Groveland.—George Donaldson has filed claims to 60,000 inches of the water of the South Fork, to be diverted one-half above and one-half below the Hardin ranch.

San Jose.—The Tuolumne Water Company has petitioned for a franchise to erect towers, poles, masts, and other superstructures along the highways of Santa Clara County.

Fillmore.—C. J. Elliott, of the Ventura County Power Company, has announced that the company has completed arrangements for the extending of its line along Sepe Avenue to supply electricity for light and power purposes along that street.

Chico.—The $20,000 power plant of the Steifer Mining Company near Magalia has been completed after a year's construction work, and the pumping of water from the mine is now under way.

Marysville.—Warren Sexton, representing the Great Western Power Company, was the only bidder before the Board of Supervisors at its last meeting for the power line franchise that was advertised for sale. The bid was $225, and was accepted.

Sacramento.—The Board of Supervisors has granted to the Great Western Power Company a franchise for a period of 50 years, to erect and operate an electric power line in Sacramento County. The bid of the Great Western Power Company for the franchise was $100.

Santa Rosa.—The contract has been let for the carrying out of one of the largest electrical projects in Northern California, namely, the construction of a power line from the generating plant of the Snow Mountain Power & Water Company, on Eel River, Mendocino County, through Ukiah, Hopland, Cloverdale, Healdsburg, Windsor, Santa Rosa, and on to Petaluma. The line has already been built as far as Talmage, two miles from Ukiah, and the poles and wire are on the ground for carrying on the construction. It will be a big enterprise, and it is predicted that it will mean a big reduction in rates for power and light when the current is turned on.

Palo Cedro.—The Northern California Power Company has commenced construction on a 60,000-volt line from its sub-station at this place to Kennet, Cal. This additional line will give Kennet four different circuits. The new line will be cut in so as to give Redding the equivalent of another circuit, making four for that city also. At Kennet another sub-station will be constructed with a capacity of 7,000 horsepower. Because of the Mammoth mine and smelter, Kennet consumes ten times as much electric power as Redding. The new transmission line will be a feeder also for the electric-process iron smelter at Heroult. This line will have a capacity to transmit 20,000 horsepower and will be 16 miles in length.

INCORPORATIONS.

San Bernardino.—Articles of incorporation have been filed by the Chino District No. 1 Water Company and the West Chino Water Company.

Los Angeles.—The Northwest Oil Company has been incorporated by R. C. Gills, E. P. Clark, R. P. Sherman, S. J. Eginton, and M. E. Hammond. The capitalization of the company is $60,000.

San Francisco.—The Keystone Electric Company has been incorporated, with a capital stock of $10,000, by S. H. Foster, George Nolan, and Wm. W. Goldnamer. A. P. Harris, of San Francisco, is attorney.

San Francisco.—Articles of incorporation have been filed with the County Clerk by the Marin Gas Company. The capital stock of the company is $15,000, and the incorporators are R. P. Greer, F. B. Turpin, W. J. Tiffany, E. D. Peixotto, and Charles Tanzer. The place of business is San Francisco.

Riverside.—Articles of incorporation have been filed for the Whitewater Land & Power Company. The company is framed for the purpose of locating, developing, purchasing, and acquiring water rights. The capital stock of the company is $500,000. The directors are H. Edwin Moore, J. E. Cowles, Arthur E. Poole, of Los Angeles; John E. Coffin, of Whittier, and W. B. Scarbourough, of Monrovia.

ILLUMINATION.

Alameda.—The electricity commission has awarded the contract for a new boiler for the electric light plant to the Risdon Iron Works for $5,100. There were seven bids in all. The commission is also figuring on installing a heating and water plant to warm the water used by the turbine engine.

Sausalito.—The Town Trustees at their last meeting were petitioned to grant a franchise to lay gas pipes in the streets to supply consumers with gas for illumination and domestic purposes. Mr. Grimwood, a well-known gas engineer, is now looking up a site in Sausalito. Messrs. Blair Trupin of Mill Valley; Robert P. Geere and W. Z. Riffany, of Sausalito, are behind the proposition.

San Francisco.—The Permanent Downtown Association of merchants, property owners, and other business men in the triangular district bounded by Sutter, Powell, and Market Streets, has presented to the Board of Supervisors a plan for lighting the retail section of the down-town district. The association, through a competitive test among the leading architects, has secured a handsome design of pole, which will adorn the streets in the day time and furnish a brilliant light in the evening. The plan provides for 160 poles, averaging eight poles to long blocks and three to short blocks. The Board of Supervisors has accepted the plan, and the city will furnish the electric current for lighting.

WATERWORKS.

Gridley.—Engineer Beebee has presented a plan for a water system to cover the whole city at a cost of from $23,000 to $30,000.

Los Angeles.—The Water Commission is taking steps to extend the chief feeding water mains for the business section of the city.

Prescott, Ariz.—Frederick W. Smith has applied to the City Council of Williams for a 25-year franchise for the installation and operation of a city water system.

Glendora.—Sanders Bros. have been awarded the contract to lay the water mains and laterals for the Monte Vista tract, which is situated between Pomona and Ontario.

Vallejo.—At the last regular meeting of the Board of Public Works of this city, the secretary was authorized to advertise for bids for 3,060 feet of 4-inch iron pipe.

Fresno.—George Scane has been granted a franchise for 50 years by the Supervisors to establish a waterworks and distributing system for the town of Fowler.

Gridley.—Last Wednesday evening at the office of the City Attorney, R. C. Long, the City Board of Trustees held an informal conference with Engineer Ralph Beebee on the subject of a waterworks system.

Los Angeles.—The Board of Supervisors has passed an ordinance granting the Lawndale Water Company, a corporation, a franchise to construct and maintain a water system upon certain highways in the County of Los Angeles.

San Dimas.—The Board of Directors of Artesian Belt and the San Dimas Irrigation Company have authorized the installation of a steel pipe system extending from the Base Line plant to the top of the bluff over the town, near Artesia Street.

Washington.—Secretary of the Interior Garfield, after seeing the President, rendered his decision to give the people of San Francisco a chance to vote on the question whether or not they want reservoir rights at Lake Eleanor and Hetch-Hetchy.

Madera.—Chairman Trede, of the Board of Trustees, wishing to have the matter of the estimates of a water and sewer system for the city revived, has appointed City Surveyor Smith, Trustees Wagner and Thurman as a committee to look into the matter of cost.

Salt Lake City, Utah.—The Telluride Realty Company, which owns Federal Heights, asked that the water main system be installed there at once, and agreed to put up a certified check for $14,002.23 for the estimated cost. The matter was sent to the waterworks committee for consideration as to details.

Coalinga.—The Pleasant Valley Water Company expects to commence work laying lines from the town to the property of the West Coalinga Oil Company as soon as pipe can be procured. The directors of this company are now in communication with parties who have suitable pipe, and are making every effort to get the work started at an early date.

San Bernardino.—Property owners of Eleventh Street, between C and D Streets, will have the advantages of city water. At the last meeting of the Board of Water Commissioners a petition was filed and granted to lay a three-inch main along the street. The commission also granted a request from Councilman D. H. Wixom for an extension of the city water service in Meadow Brook Park, where some 700 feet of new mains will be laid.

OIL.

Richmond.—A. J. Timmons, manager of the Richmond Iron Foundry, at Outting Ferry Terminal, has taken in a large contract of oil-tank construction for the Associated Oil Company.

Yerington, Nev.—Col. W. G. Gregory, of Yerington, reports that he has discovered within 40 miles of Yerington good indications of oil, and that he has taken up several hundred acres of the land. It is stated that this land is on the oil belt recently discovered in Mono County, Cal., where wells are now being drilled.

Bakersfield.—A. Mills, of Clifton, Ariz., and B. Mills, superintendent of the Morenci Copper Mills at Morenci, Ariz., were here last week to inspect some oil lands about four miles south of McKittrick, which they own. They were taken out by C. E. Getchell, and it is learned that they will begin development work in a short time.

Los Angeles.—A combination oil land and real estate deal has just been made, wherein C. H. Hillman, a Seattle millionaire, becomes the owner of 5,000 acres of land near La Costa, 12 miles south of Oceanside. Mr. Hillman will bore for oil. Machinery costing between $25,000 and $30,000 is already on the ground, and the derricks are up. The operations will begin within a week upon three wells.

Los Angeles.—The Consolidated Petroleum Company has its well down 300 feet in the first oil well on the Wolfskill ranch in the western end of the Sherman district. There are several strings running on this property. President Gabel says he does not anticipate having to go below 1,500 feet, which is not as deep as most of the Amalgamated wells. On a lease on only 12 acres on the Schwoll ranch, just on the edge of the town of Sherman, a well has just spudded in. When the lease was being made, one of the owners demanded to know who was back of the enterprise or a heavy cash deposit. He was assured that it was the Standard. About the time this was done, Col. J. J. Carter, the Standard's highest authority on the Pacific Coast, was in the city.

TRANSPORTATION.

Los Angeles.—The Los Angeles Interurban Railway Company has been granted a franchise to operate upon a portion of Mountain Avenue.

Redlands.—After a heated debate both for and against the proposition, the Supervisors have decided to offer for sale the franchise asked for by the Redlands Central Railway Company of this city.

Tucson, Ariz.—Frank Adams, proprietor of Naco Hotel, in Naco, Ariz., reports that it is quite probable that eventually the car line which is at present in operation between Bisbee and Warren will be continued to Naco.

Oroville.—It is the report here that with the completion of the Oroville-Nelson cut-off the Southern Pacific Company will install a number of gasoline motor cars that will come into more direct competition with the Northern Electric Company's interurban system. The motor cars can serve all the towns now served by the electric road and many more, going further to the north and having the Marysville-Woodland branch to aid it.

TRANSPORTATION.

San Jose.—At the last meeting of the City Council an ordinance was passed granting L. E. Hanchett an extension of one year in which to complete and put in operation an electric street railroad on portions of First, Second, Third, Fifth, Eighth, West Virginia, Orchard, Goodyear, Keyes, and Washington Streets, provided that he shall co-operate with the city at any time street work is commenced on any of these thoroughfares.

Sacramento.—Judge J. B. Devine has petitioned the Board of Supervisors for a franchise for a street railway in and about Oak Park, Gould, and Carleton. Judge Devine said the application was made on behalf of W. T. Garrett and other capitalists of San Francisco. The proposed railway would be six miles in length and would afford accommodation to a present population of 7,500. Under the ordinance, which was read, it is proposed to construct a double-track trolley line, to be operated by electricity or other motive power than steam.

San Francisco.—If the United Railroads will pay a monthly rental of $1,000, build a safety station on Market Street, at Front, and permit municipality-owned roads, or roads yet to be built, to operate cars on lower Market Street, the Supervisors will issue a permit for the company to operate the electric cars of the Sutter Street line from Sutter Street to the ferry. This was the decision reached by the Public Utilities Committee at its last meeting. The committee is composed of Supervisors Giannini, McLeran, and Murphy, though there were present at the meeting Supervisors Payot, McAllister, Bancroft, Johnston, Murdock, and Comte. President Boeckman, of the Sutter Street line, was in attendance at the meeting, and when the ultimatum was reached he announced that it would be useless to present it, as it would not be accepted. The question of the Sutter Street line came up indirectly, as the result of a proposition made to grant the company a franchise to lay down tracks and operate an overhead electric line from Third and Townsend Streets to the mail docks, a distance of three blocks. Supervisor McAllister had undertaken to get this line constructed, and to that end had waited upon the United Railroads people. The Supervisors present were much opposed to legalizing the Sutter Street cars operating on lower Market Street unless the city got more out of it than three blocks of electric line to reach the mail docks, the permit for which the committee expressed its willingness to grant at any time the company desired it.

FINANCIAL.

San Francisco.—The Big Pine Surplus Water Storage Company has made an assessment of 25 cents per share, delinquent May 9th, sale day June 1st.

San Francisco.—Assessment of one-half cent per share, delinquent May 20th, sale day June 12th, has been made on the stock of the Encinal Oil Company. W. J. Nimmo is secretary.

Orange.—At the last meeting of the Board of Trustees, a petition was presented, headed by J. P. Small and Robert Hays and signed by 138 names, asking that an election be called to vote $40,000 bonds to purchase a gas plant.

Los Angeles.—Although new, the City Gas Company has a working capital of a few thousand less than $1,000,000. More money is needed to carry on the plans of the management and more bonds will be issued. The stock is held by 57 individuals at present.

San Francisco.—The comparative statement of the earnings of the Petaluma & Santa Rosa Railway Company for the month of March of last year and this year is as follows: Gross earnings, 1907, $13,782.41; for 1908, $16,274.41. Operating expenses 1907, $12,086.01; for 1908, $14,139.30. Net earnings for 1907, $1,696.40; for 1908, $2,135.11.

San Francisco.—The comparative statement of the Edison Electric Company's earnings for March are as follows: Gross earnings for 1907, $160,713.98; for 1908, $193,442.30. Operating expenses for 1907, $80,934.13; for 1908, $118,366.72. Net earnings for 1907, $79,779.85; for 1908, $75,075.58. Fixed charges for 1907, $47,377.91; for 1908, $50,169.26. Surplus for 1907, $32,401.94; for 1908, $24,906.32.

New York.—The annual report of the United Railroads Investment Company shows a decrease in the net income of $320,000, and about met expectations. The profit and loss surplus of $824,900 is equal to over 5 per cent on preferred stock. Referring to the effect of the strike, etc., President Thalman says that existing conditions in San Francisco justify the belief that the future prosperity of the city is assured, in which the United Railroads will fully participate.

INCORPORATIONS.

San Francisco.—The Foxall Oil Company has been incorporated, with a capital stock of $500,000, by Jos. Seeley, A. L. Weil, and E. B. Davis.

Eureka.—A. Waldner, M. C. Hast, W. C. Elsemore, J. Hamner, T. H. Chope, and E. G. Kramer have incorporated the Crystal Water Company at Eureka, with a capital stock of $500,000.

Bakersfield.—Articles of incorporation have been filed by the Arcturiss Oil Company, with a capitalization of $400,000, by Fred Phillips, W. C. Price, J. D. Wood, C. O. Morgan, and W. E. Mitchell.

Bakersfield.—The Salt Lake Oil Company, with a capital stock of $500,000, has been incorporated. The incorporators are J. D. Wood, J. E. Bamberger, Fred Phillips, W. C. Price, and C. O. Morgan.

San Francisco.—The National Electric Device Company has been incorporated with a capital stock of $50,000 by B. L. York, E. P. Norwood, and C. M. Boyd. The place of business is San Francisco.

San Francisco.—The Weidenthal-Gosliner Electric Works has been incorporated, with a capital stock of $100,000, by S. H. Weidenthal, Herbert Gosliner, and S. M. Samter. The place of business is San Francisco.

San Bernardino.—The San Bernardino Valley Telephone Company, of Ontario, has been incorporated, with a capital stock of $200,000, by J. A. Fletcher, J. N. Hartley, R. L. Dunbar, and R. P. Carder, all of Ontario.

Martinez.—Articles of incorporation have been filed by the Carquinez Electric & Construction Company, with a capital stock of $20,000. The directors are E. W. Jensen, Jos. Mayo, C. L. Pingree, F. C. Woolcott, and M. C. Arnold.

Back East Cheap

Low rate summer excursion tickets sold to Eastern points on these dates

June 3, 9, 10, 11, 15, 16, 22 to 28 inc.
July 6, 7, 8, 28, 29
August 17, 18, 24 and 25.

Here are some of the rates:

Omaha	$ 60.00
Council Bluffs	60.00
Kansas City	60.00
Chicago	72.50
St Louis	67.50
New Orleans	67.50
Washington	107.50
Philadelphia	108.50
New York	108.50

Tickets good for three months—some cases longer. Stopovers and choice of routes going and coming.

See nearest agent for details.

SOUTHERN PACIFIC

TICKET OFFICES

884 Market Street, San Francisco, Cal.
14th and Franklin Sts. Oakland, Cal.

DUNCAN METERS

Both Direct and Alternating Currents

House Type to 1,500 amp. Switchboard Type to 15,000 amp.
Read in Kilowatt Hours or Dollars and Cents.

PACIFIC COAST AGENT:

G. A. WILBUR,

22 FIRST STREET, - - - - SAN FRANCISCO, CAL.

Duncan Electric Manufacturing Co.
Lafayette, Ind.

Material for Pole Line Construction

Foundry, Machine and Wood Shop Work of all Description
Prompt Delivery.

BENICIA IRON WORKS **Benicia, Cal.**
San Francisco Office, Monadnock Bldg.
Phone, Temporary 2191

Barnes-Lindsley Manufacturing Co.

OREGON FIR CROSS ARMS

Large or small shipments by Rail or Water.
Write for Delivered Prices.

P. O. Box 274 **PORTLAND, ORE.**

Classified List of Advertisers

Alternators
General Electric Co.
Standard Electrical Works.
Western Electric Co.

Aluminum Electrical Conductors
Pierson, Roeding & Co.

Annunciators
Electric Appliance Co.
Partrick, Carter & Wilkins Co.
Standard Electrical Works.
Sterling Electric Co.
Western Electric Co.

Asbestos Products
Johns-Manville Co., H. W.

Bases and Fittings
Chase-Shawmut Co.

Batteries, Primary
Standard Electrical Works
Western Electric Co.

Batteries, Storage
Electric Storage Battery Co.
Standard Electrical Works.
Sterling Electric Co.
Western Electric Co.

Boilers
Keystone Boiler Works
Moore, C. C. & Co., Inc.
Robb-Mumford Boiler Co.
Standard Electrical Works
Tracy Engineering Co.

Boiler Compounds
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

Buffers
General Electric Co.
Northern Electrical Mfg. Co.

Building Material
Bonestell, Richardson & Co.
Johns-Manville Co., H. W.
Paraffine Paint Co.

Cable Connections
Dossert & Co.

Carbons
Reisinger, Hugo

Cable Clips and Hangers
Chase-Shawmut Co.

Circuit Breakers
Electric Appliance Co.
Fort Wayne Electric Works
General Electric Co.
Standard Electrical Works.
Sterling Electric Co.

Condensers
O. C. Goeriz & Co.
Moore, Chas. C. Co., Inc.

Conduits
American Circular Loom Co.
Electric Appliance Co.
National Conduit & Cable Co.
Pierson, Roeding & Co.
Standard Electrical Works.
Sterling Electric Co.

Conduit and Moulding Hangers.
Chase-Shawmut Co.

Conduit Fixtures
Bossert Electrical Con. Co.
Electric Appliance Co.
Standard Electrical Works.
Sterling Electric Co.

Cooling Towers
O. C. Goeriz & Co.
Moore, Chas. C. Co., Inc.
Tracy Engineering Co.

Cross Arms
Electric Appliance Co.
Sterling Electric Co.

Dynamos and Motors
Brooks-Follis Elec. Corp.
Crocker-Wheeler Co.
Electric Appliance Co.
Fort Wayne Electric Works
General Electric Co.
Northern Elec. Mfg. Co.
Standard Electrical Works
Sterling Electric Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Elevators
Van Emon Elevator Co.

Electric Grinders
General Electric Co.
Northern Electrical Mfg. Co.
Standard Electrical Works.
Western Electric Co.

Electric Heating Devices
Electric Appliance Co.
General Electric Co.
Johns-Manville Co., H. W.
Standard Electrical Works.
Vulcan Electric Heating Co.

Electrical Instruments
Cutter Co., The
Electric Appliance Co.
Fort Wayne Electric Works
General Electric Co.
Johns-Manville Co., H. W.
B. F. Kieruliff, Jr. & Co.
Sterling Electric Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.

Electrical Machinery
Crocker-Wheeler Co.
Electric Appliance Co.
General Electric Co.
Northern Electrical Mfg. Co.
Standard Electrical Works
Sterling Electric Co.
Western Electric Co.

Electric Polishers
Northern Electric Mfg. Co.

Electric Railway Appliances
Pierson, Roeding & Co.
General Electric Co.
B. F. Kieruliff, Jr. & Co.
Johns-Manville Co., H. W.

Electrical Supplies
Brooks-Follis Elec. Corp.
Chase-Shawmut Co.
Electric Appliance Co.
General Electric Co.
Northern Electrical Mfg. Co
Standard Electrical Works
Johns-Manville Co., H. W.
Sterling Electric Co.
Westinghouse Elec. & Mfg. Co.
Western Electric Co.

Electric Ventilating Fans
General Electric Co.
Northern Electrical Mfg. Co.
Standard Electrical Works.
Sterling Electric Co.
Western Electric Co.

Engines, Boilers, Heaters, etc.
Moore, Chas. C. Co., Inc.

Engineers, Chemical
Moore & Co., Chas. C., Inc.
Smith, Emery & Co.
Standard Electrical Works
Tracy Engineering Co.
Westinghouse Machine Co.

Engines, Gas and Gasoline
Moore & Co., Chas. C., Inc.
Westinghouse Machine Co.

Engineers and Contractors
Brooks-Follis Elec. Corp.
Cory, C. L.
Copeland, Clem A.
Goeriz & Co. O. C.
General Electric Co.
Jackson, D. C. & W. B.
Moore, C. C. & Co., Inc.
Smith, Emery & Co.
Standard Electrical Works.
Sterling Electric Co.
Thaxter, H. C.
Tracy Engineering Co.
Van Norden, Rudolph W.
Western Electric Co.
Westinghouse Elec. & Mfg Co.

Feed Water Heaters and Purifiers
Moore, Chas. C. Co., Inc.
Tracy Engineering Co.
C. H. Wheeler Mfg. Co.

Fire Proofing
Johns-Manville Co., H. W.

Fuses and Fuse Devices
Chase-Shawmut Co.
Electric Appliance Co.
General Electric Co.
Johns-Manville Co., H. W.
Standard Electrical Works.

Ground Connection Clamps
Chase-Shawmut Co.

House Goods
Electric Appliance Co.
Partrick, Carter & Wilkins Co.
Standard Electrical Works.

Hydraulic Machinery
Goeriz & Co., O. C.
Moore, Chas. C. Co., Inc.
Pelton Water Wheel Co.
Standard Electrical Works.
Tracy Engineering Co.

Injectors
Vulcan Iron Works

(Continued on second page following.)

Dearborn Preparations **KEEP BOILERS CLEAN. —— GET OUR PROPOSITION.**

Dearborn Drug and Chemical Works - Offices, Laboratories and Works - Chicago
San Francisco, 301 Front St. - - Los Angeles, 355 E. Second St.